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BARE BEACH
LOGISTICS OVER-THE-SHORE:
AN OUTDATED CONCEPT?

GRADUATE RESEARCH PAPER

Christopher J. Pehrson, Major, USAF

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GRADUATE RESEARCH PAPER

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Abstract

This paper is a critical review of bare beach logistics over-the-shore (LOTS) operations. It examines the utility of the bare beach and asks if this method of LOTS is still viable for today's military. It begins with a general description of LOTS and describes unique characteristics of the bare beach operation. It then reviews the history of LOTS from World War II through the present day. This historical perspective gives insight into the utility LOTS provided in past campaigns and what might be expected of LOTS in support of present day operations. It then investigates three constraints limiting the utility of bare beach LOTS operations: the number and location of watercraft, sea state minimums, and infrastructure beyond the beach. This review of bare beach LOTS reveals that it is a high-cost, high-risk, and often unreliable operation that does not meet operational requirements of the regional warfighting CINCs.

Next the operation is viewed from the warfighter's perspective. From this vantage, bare beach LOTS may be the logistics support option with the lowest operational cost, and therefore of great utility regardless of the logistical cost. In conclusion, this paper emphasizes the need to improve and enhance bare beach LOTS capability to adequately support the warfighter.

BARE BEACH
LOGISTICS OVER-THE-SHORE:
AN OUTDATED CONCEPT?

I. Introduction

Background

Fundamental to the national military strategy of the United States is global power projection. In response to a changing world order and evolving threats, our military strategy has shifted from one of forward presence to one of force projection. Since the collapse of the Soviet Union in 1989 forces garrisoned overseas have drawn down dramatically and are currently ill-equipped for anything but short-duration or small-scale contingencies. Even so, these forces can not employ beyond their garrisoned location and will typically forward deploy with augmentation from the continental United States to a crisis location. This new strategy relies upon a robust and responsive logistics system that is capable of transporting, supporting, and sustaining armed forces around the globe. The lifeblood of this power projection capability is the throughput of men and material to support a military campaign. Historically, strategic sealift has transported 90 percent or more of the supply and sustainment material to the theater. Because we rely so heavily on the sea route to support military campaigns, logistics over-the-shore (LOTS) operations are a vital part of our logistics system.

LOTS is the process of discharging cargo from vessels anchored offshore or in-the-stream, transporting it to shore or pier, and marshalling it for movement inland.

LOTS operations range in scope from bare beach operations to operations supplementing fixed-port facilities and intratheater movements (Joint Pub 4-01.6:Sec I, 3). This research paper will focus on the bare beach concept of operations. From an economic and logistical perspective the bare beach option is the most costly. The equipment to accomplish bare beach LOTS is expensive to procure and maintain. Training personnel is expensive and time consuming. And, logistically, bare beach throughput is less than other LOTS options such as degraded port or robust port operations. Bare beach LOTS also entails risk from an operational perspective. Successfully discharging cargo over a bare beach is contingent upon relatively calm seas and fair weather--unpredictable factors during time-critical military operations.

Added to the high-cost and high-risk aspects of bare beach LOTS is the reduced capability of the military to perform LOTS operations since the post-Cold War drawdown. The Department of Defense watercraft fleet, the workhorse of moving cargo from ship to shore, is smaller and no longer forward deployed. Do the limitations of high-cost, high-risk, and scarce resources suggest that bare beach LOTS is no longer a viable concept? Should the military instead abandon the bare beach and focus on port-only operations, even if the port is little more than a small fishing village? These questions demand a critical review of bare beach LOTS as a concept of operation. Drawing on the historical record of bare beach operations, the capability of existing LOTS resources, and expected power projection requirements, this research paper attempts to quantify how effectively bare beach LOTS can support today's national military strategy.

Research Questions

The fundamental question is: Does the bare beach LOTS operation provide adequate utility for today's military? Bare beach LOTS, in and of itself, is not a strategy. It is part of the complex process of supporting the theater commanders as they prosecute a military campaign. The theater commander-in-chief (CINC), or warfighter, determines the logistics requirement necessary for military success at the lowest operational cost. This is not the same as the lowest economic cost or the lowest logistics cost. Ideally the warfighters minimize operational cost by having every conceivable resource and option at their disposal to achieve a decisive victory in combat. Unfortunately, the realities of limited resources and budget constraints force us to weigh the costs and benefits of each capability vested in the military. Assessing the utility of bare beach LOTS requires further investigative questioning to reveal those costs and benefits.

This research begins by defining bare beach LOTS and identifying the unique characteristics of this operation. This area of investigation will address the challenges of bare beach operations. Next, this research will review logistics over-the-shore operations from World War II through the present day to illustrate the role of LOTS in military operations and demonstrate the utility of bare beach LOTS. Historical data illustrate the differences in cargo throughput between bare beach operations and port operations, as well as the contribution of intratheater sealift LOTS. Extrapolating the logistics throughput of historical operations to the expected throughput requirements of today's expeditionary forces will help quantify how much utility bare beach LOTS can provide to the warfighter. The paper will then return to a review of the bare beach and focus on three constraints that limit bare beach LOTS operations. Specifically, these constraints are the number and location of watercraft, sea state minimums, and beach clearance of cargo. They will be quantified to assess the practical utility of bare beach LOTS operations to the warfighter.

Finally, the operational cost of not having a bare beach LOTS capability will be assessed from the warfighter's perspective. This area of investigation will assess what military capability would be jeopardized by the inability to execute bare beach LOTS. Given the assessment of bare beach utility from the first investigative question and the assessment of bare beach constraints from the second investigative question, this final area of investigation will quantify what utility the warfighter would lose without bare beach LOTS. We will then be ready to address the fundamental question of whether or not bare beach LOTS provides <u>adequate</u> utility for the warfighter. In short, this research will attempt to answer that question through the following investigative questions:

1) What does history tell us about the utility of bare beach LOTS?
2) How do constraints of bare beach LOTS limit the utility of this operation?
3) What is the operational cost of abandoning bare beach LOTS?

Research Focus

The issues surrounding the utility of bare beach LOTS operations are complex and broad in scope. This research paper focuses on the primary constraints of bare beach LOTS--watercraft, sea state minimums, and beach infrastructure--to quantify how much support this operation can provide to the theater CINC. Reviewing the historical record will reveal the utility that bare beach operations provided warfighters in the past. From this we will garner what might be expected from today's force structure.

The final analysis of whether there is enough utility in bare beach LOTS is subjective. In this analysis, LOTS must be viewed from within the framework of how it enhances support to the warfighter. Capturing the costs and benefits of bare beach LOTS as a part of the overall logistics support system will enable military leadership to make informed policy decisions. This research paper does not attempt to offer the best logistics over-the-shore solution, only to examine the bare beach concept of operations and emphasize that military leadership must decide on future requirements before allocating scarce manpower and material resources.

Assumptions/Limitations

The scope and focus of this research is limited to the operational utility of bare beach LOTS and does not address budgetary constraints. Budgetary concerns certainly impact military capability, but the decision to retain or abandon the bare beach concept of operations must first be based on its utility to the warfighter. The training and operating costs to maintain a bare beach LOTS capability are tremendous. Training for bare beach LOTS is arguably the single most expensive training activity for today's military. A robust exercise includes commercial sealift, U.S. Navy ships and support equipment, U.S. Army watercraft and support equipment, and 1,000 or more personnel. The cost of such an exercise is approximately $300 million (Watkins, 2000). Annual operating costs are also daunting. Maintaining the combat readiness of the U.S. Army watercraft fleet required a system budget of over $60 million in FY99 (Cannon, 1999). From an economic perspective, bare beach LOTS is certainly a lucrative target for budget cuts. But if this capability is deemed essential to the warfighter, then this price must be paid at the expense of other lower priority programs.

Preview

Chapter II defines logistics over-the-shore operations and describes the unique characteristics of bare beach LOTS. It lays the foundation of how LOTS fits into the campaign plan and supports the warfighter. This chapter will also briefly describe the different types of LOTS operations and the equipment used to accomplish the mission.

Chapter III is an overview of the history of bare beach logistics operations. The lessons from military campaigns of the past will provide a perspective on the throughput capability of bare beach LOTS. Although technology and techniques have evolved over the past 50 years, there are still many aspects of over-the-shore logistics that are as applicable today as they were in World War II. Historical data also illustrate the difference in throughput between bare beach operations and port operations. The historical throughput capability revealed in this chapter will later be compared to the expected throughput requirements of modern expeditionary forces.

Chapter IV emphasizes the three factors that currently constrain throughput of cargo over the bare beach. These constraints are the number and location of U.S. Army watercraft, sea state minimums, and beach infrastructure. This chapter establishes an expected capability that bare beach LOTS operations present to the theater CINCs in terms of logistics support.

Chapter V builds upon the information gathered in previous chapters and assesses the operational cost of not having a bare beach LOTS capability. It discusses the impact on logistics support to the warfighter and the implications of the military losing its bare beach capability. This chapter does not attempt to marginalize the bare beach concept, but rather explores the effect on the overall logistics support system if bare beach LOTS is no longer an option. It outlines the implications of either retaining bare beach LOTS capability or abandoning it in favor of other logistics concepts. In the conclusion, it addresses the overarching question of the whether there is adequate utility in bare beach LOTS for the warfighter. Emphasis is placed on the need for clear policy directives and programming decisions.

II. Bare Beach LOTS Operations

The wars and battles fought by the United States in the past one hundred years have not been fought on American soil. Our expeditionary forces rely upon sea lanes and air routes to supply and sustain them in foreign lands. Ideally, friendly nations would open their seaports and airports and allow the use of existing infrastructure for the reception and staging of our military forces. History and prudence tell us that this will not always be the case. Hostile or neutral nations may deny use of their facilities. Even friendly nations may not be capable of receiving the amount of material required through their existing seaports and airports. In situations where the existing infrastructure is not adequate, the theater commander has LOTS at his disposal.

LOTS can be an Army only operation, a Navy only operation, or a combined Army and Navy operation. When both services perform LOTS it is called joint logistics-over-the-shore (JLOTS). Because LOTS is a highly specialized logistics operation with its own lexicon of terms and acronyms, a glossary is included at Appendix A for reference. LOTS or JLOTS is not a combat operation, it is a combat support operation and must be performed in a permissive environment. Friendly forces must control the sea lines of communication leading to the shore, the cargo discharge location at the shore, and the marshalling areas beyond the shore. This contrasts with combat operations from the sea to the shore, which are called amphibious operations (Joint Pub 4-01.6:Sec II, 1). In a non-permissive environment, an amphibious operation might set the stage for a follow-on LOTS operation but LOTS can not be accomplished when in contact with the enemy. The distinction between the logistics support of an amphibious operation and the logistics activity of a LOTS operation is primarily a functional and command-and-control distinction. An amphibious operation is executed to establish a beachhead in enemy territory. The amphibious task force commander will direct and control all aspects of the assault. He or she is a *supported* commander in charge of ship to shore combat operations. In contrast, the function of a LOTS operation is over-the-shore logistical support to the warfighter. The designated LOTS commander is a *supporting* commander responsible for planning and executing movement of material from strategic sealift ships to designated locations over the shore where it will be marshaled for onward movement to support the warfighter's combat operations.

What is LOTS?

Broadly defined, LOTS is the movement of men and material from ship to shore when ocean-going vessels cannot discharge directly to the pier. There are many varieties of LOTS and there are many different types of equipment used to perform this operation. Figures 1 and 2 and the compendium of equipment included at Appendix B will help the reader conceptualize LOTS operations. The augmentation of fixed-port facilities to increase cargo throughput is one form of LOTS. Figure 1 is a stylized depiction of port augmentation JLOTS (Thede and others, 1995:D-9). In this instance, stategic sealift ships waiting for access to a pier could begin discharging their cargo in-stream. The cargo would be offloaded to a floating dock such as a floating causeway, a cargo offload and discharge system (COLDS), or a roll-on/roll-off discharge facility (RRDF). From the floating dock, lighterage would transport the cargo to the pier. This type of operation could also be used if a fixed port is unable to receive a large ocean-going vessel due to shallow draft or harbor obstacles.

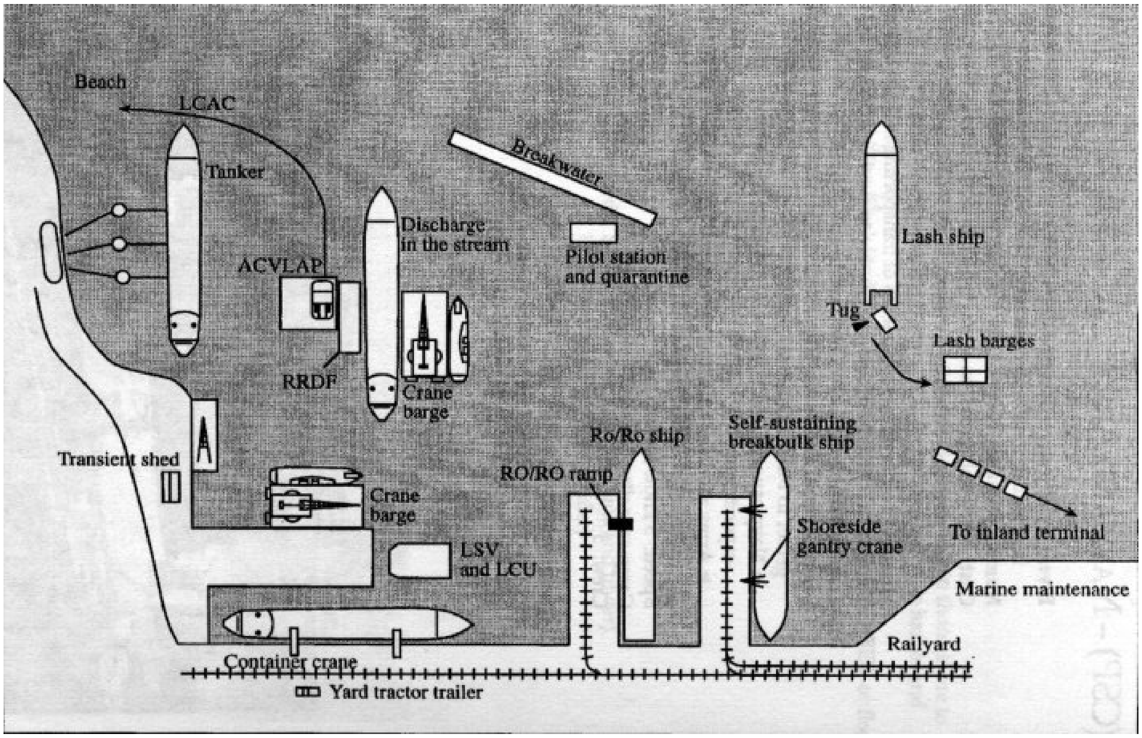

Figure 1. JLOTS Operational Area (Port Operations)

A study in 1994 conducted by the Institute for Defense Analysis (IDA) examined the role of JLOTS in the U.S. European Command area of responsibility (Buchanan, 1994:13-16). This study emphasized the offload limitations of the U.S. strategic sealift fleet and why LOTS is so important to successful cargo throughput. The primary vessels in the U.S. strategic sealift inventory include the Ready Reserve Fleet (RRF), Maritime Prepositioned Ships (MPS), Fast Sealift Ships (FSSs), and Large Medium Speed Roll-on/Roll-off ships (LMSRs). The trend in the strategic sealift fleet has been towards larger vessels because they can transport cargo with greater speed and efficiency (Beary, 1997:2). When carrying maximum cargo, these ships have drafts of up to 11.6 meters and require berths of at least 12 meters deep. The IDA study concluded that of 102 major ports considered in Europe and Africa, only 30 have berths deep enough to accommodate vessels requiring berths of 12 meters and only 52 could accommodate vessels requiring berths of 10 meters (Buchanan, 1994:15). The inaccessible ports can be serviced in one of two ways. Either the vessels must perform in-stream discharge in deep water away from the shore using LOTS procedures or they must reduce their draft by entering the ports with less than their maximum cargo tonnage. According to the IDA report, in order to gain access to shallow berths in Saudi Arabia, the average weight of cargo carried by Desert Shield ships was only 23 percent of the ship's maximum load (Buchanan, 1994:17). This limitation is even more dramatic when one considers that most MPS vessels prepositioned around the globe are near or at maximum draft.

Present day strategic sealift is more dependent than ever before on "deep-water ports or the ability to efficiently offload ships in-stream and ferry cargo to shore by lighterage" (Beary, 1997:2). During Operation RESTORE HOPE in Somalia the first three MPS ships to respond could not offload in the port of Mogadishu because the harbor was too shallow. According to Beary (Beary, 1997:2):

> One went to Kismayo where the port was hardly better, and two of the three [MPS] ships returned to Diego Garcia after 14 days without having unloaded their cargo. All three had the ability to offload "in-stream," but nobody planned for it.

The cargo of the prepositioned MPS ships, force opening modules critical to the warfighter, can not simply be offloaded to reduce draft. If they can not access deep water ports then they must perform in-stream LOTS discharge to an existing port or over the bare beach.

Over the Beach

Another form of LOTS is the bare beach operation. This option is viable when port access is denied or impractical. It consists of lighters delivering cargo directly to an unimproved or undeveloped shore. Figure 2 is a depiction of a bare beach JLOTS

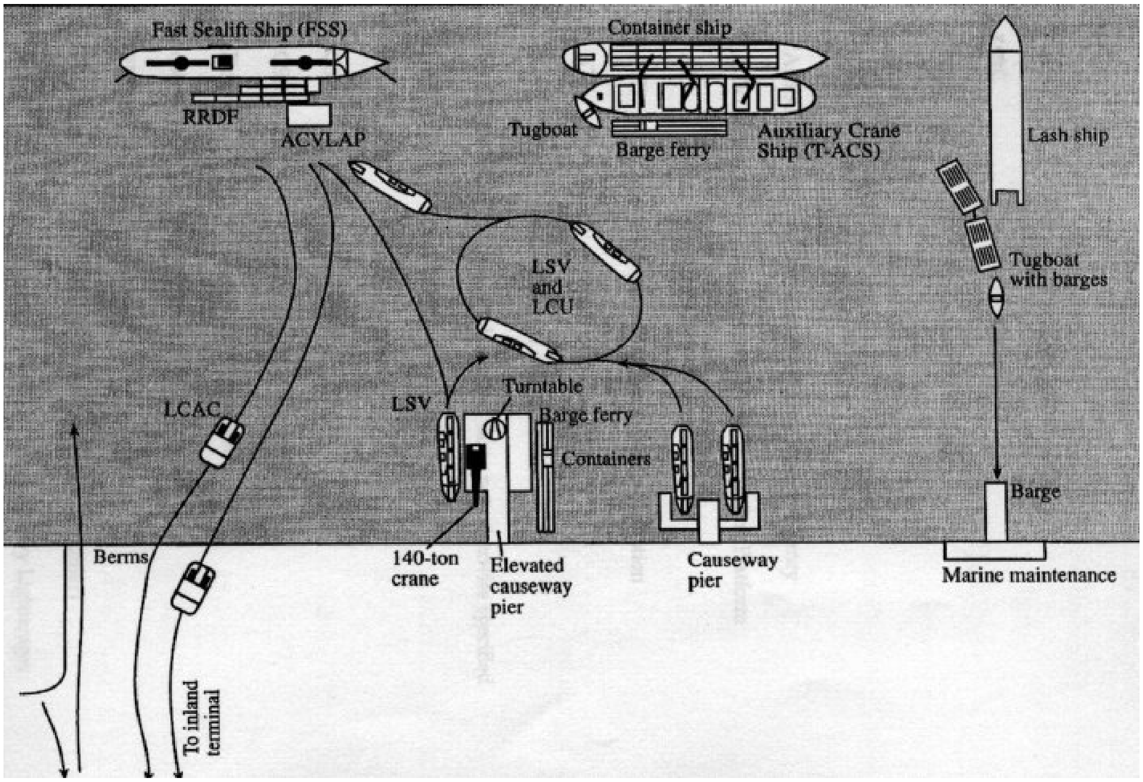

Figure 2. JLOTS Operational Area (Bare Beach)

operation (Thede and others, 1995:D-10). The lighters may be delivering cargo from a ship anchored a few miles offshore or they may be performing an intra-theater sealift mission from an intermediate staging port. In either case, they will be offloading their cargo directly onto the beach. This is more complex than a port operation and is generally an inefficient and risky method of delivering cargo from ship to shore.

The bare beach LOTS operation has unique concerns and characteristics beyond those of port augmentation LOTS. Since there is no existing port, the beach must be surveyed and prepared. This is time consuming and must be accomplished before LOTS operations commence. In the planning stage, beach reconnaissance must be accomplished to determine a suitable LOTS site. The selected site must be accessible to main supply routes, accessible for lighterage and causeway installation, and have suitable beach crossing roads and beach hard stands (Joint Pub 4-01.6:Sec IV, 11). A hydrographic survey must be accomplished to determine beach gradient and underwater topography. The selected location must have lighterage discharge sites that are clear of debris and rocks. If the beach surface can not support the weight of MHE or cargo, then roadways must be constructed. Roadways must also be constructed for beach exit to ensure cargo can be cleared from the beach for onward movement. During OCEAN VENTURE 93 a Navy construction battalion and Army engineers required six days to install approximately 75,000 square feet of surfacing material to prepare beach access roads for JLOTS operations (JLOTS III Throughput Test, 1994:7). A cargo marshalling area must be prepared. Depending on the operation, the marshalling area may need to accommodate containerized cargo, breakbulk cargo, wheeled or tracked vehicles, or bulk liquids. A separate area would also be required for the storage of ammunition (Joint Pub 4-01.6:Sec IV, 15). Because the bare beach LOTS mission is more complex than the port augmentation mission, planning and beach preparation will require substantially more time. IDA summarizes this in their report (Buchanan, 1994:E-5):

> When used to augment the berth capability of a port, a JLOTS system can be set up in a matter of a few days. Alternatively, if the vehicles and cargo must be transported across the surf line onto a beach, the installation of the elevated causeway may take 14 to 30 days for a 810 and 3,000 foot pier, respectively.

These planning and preparation concerns must be addressed before the bare beach LOTS operation can even begin to move cargo over the beach.

Other unique characteristics of bare beach LOTS must be also be addressed if the operation is to be successful. Unlike operations at a fixed port where some form of port infrastructure generally exists, the bare beach operation must construct an entire port facility from naught. When discharging cargo at an existing port some cargo handling equipment may be available from commercial or host nation sources. To accomplish bare beach operations, commercial equipment is neither available nor capable of performing the operation. Special cargo handling equipment, able to operate on unimproved and rough terrain, must be delivered to the beach area as part of the initial cargo deliveries. This displaces material critical to the warfighter. At existing ports, contract labor may be available to perform cargo handling, stevedore, and longshoreman duties. At the bare beach, all equipment and manpower is organic to the military and must transported to the LOTS operational area. Again, this will displace material critical to the warfighter.

This chapter provided a brief overview of LOTS operations and its importance in support of the military campaign. The bare beach LOTS operation was shown to be the most complex method of delivering cargo from ship to shore. Its unique characteristics, beyond those of the port augmentation LOTS mission, make bare beach LOTS more costly to the warfighter in terms of planning, preparation, and required resources. Table 1 summarizes the issues and considerations discussed in this chapter that are unique to bare beach operations. We now have the foundation required to investigate the utility of bare beach LOTS operations. The next chapter will review examples of LOTS operations from World War II through the present day. This historical perspective will quantify the differences in throughput and efficiency between port augmentation and bare beach operations. In Chapter IV we will return to our assessment of bare beach LOTS and address three factors that constrain cargo throughput over the beach: the number and location of U.S. Army watercraft, sea state minimums, and infrastructure beyond the beach. By focusing on these constraints we will be able to quantify the logistics support that bare beach LOTS affords the warfighter and gain better insight into the utility of this operation.

Table 1. Issues Unique to Bare Beach LOTS

Bare Beach Consideration	Issue
LOTS Planning and Site Selection	Requires beach reconnaissance, beach survey, and hydrographic survey
Lighterage Discharge Sites	Beach approach lanes must be clear of obstructions and debris
Beach Surfacing Material	Required if beach weight bearing capacity is too low. Built by engineers using reinforced matting, sand grid, crushed rock, or gravel.
Cargo Marshalling Area	Must be constructed to have access from beach and access to inland roadways
Floating Causeway (FC)	Required for container or breakbulk cargo discharge
Elevated Causeway System (ELCAS)	Required if lighters are unable to operate within beach surf zone
Rapidly Installed Breakwater System (RIBS)	Artificial breakwater designed to improve sea state. Can be used near the beach to protect shore operations or at an in-stream discharge facility
Rough Terrain Forklift (RT Forklift)	Required for breakbulk cargo handling
Rough Terrain Container Handler (RTCH)	Required for containerized cargo handling
Rough Terrain Crane (RT Crane)	May be required for lifting heavy or outsized cargo
Manpower Considerations	All cargo handling, stevedore, and longshoreman duties must typically be performed by military personnel whereas contract labor may be available at commercial seaports

III. Historical Perspective

This chapter will review historical examples of over-the-shore logistics. Fifty years of experience and new technologies have improved LOTS capability but many of the aspects and principles of this operation are as applicable today as they were during World War II. Although the scale and scope of operations is arguably less today, the differences between port augmentation LOTS and bare beach LOTS are the same as they were during the Normandy invasion. Reviewing the history of over-the-shore logistics will enable this research to quantify what capability the operation offers the warfighter. The historical data include military operations and training exercises for both bare beach and port augmentation LOTS.

Logistics over-the-shore operations have been a part of every major military campaign since WWII. The Second World War saw the genesis of modern logistics as an art and science and LOTS was a major part of this development. American expeditionary forces required tremendous amounts of material to sustain combat operations. These supplies were almost exclusively delivered by sealift, often using techniques developed to deliver cargo when ports were not available. LOTS procedures were used in Sicily, Italy, Normandy, and throughout the Pacific. After WWII, LOTS operations played and important role supporting U.S. and United Nations forces in the Korean War. During the Vietnam War, watercraft were used to transport cargo from major ports such as Cam Ranh Bay through the rivers and canals of the Mekong Delta. In the Persian Gulf War, the 7th Transportation Group "developed a plan to operate a logistics-over-the-shore operation if a Kuwaiti port could not be taken and used" (Krause and Pagonis, 1992:6). The recent campaign in Kosovo also included LOTS operations when cargo was transported between ports in Italy and Croatia using Army LSVs. This historical record reveals insight into the utility of LOTS and how this operation has supported the warfighter.

Other sources of information about the utility of LOTS are the results and lessons learned from military training exercises. In the next chapter we will review LOTS training exercises and the constraints of modern day LOTS operations. Before reviewing this exercise data we will first turn our attention to the operational history of LOTS.

World War II

After the defeat of the Germans and Italians in Northern Africa, General Eisenhower was ready to begin the Allied assault on Southern Europe. Operation HUSKY, the invasion of Sicily, was set for July 10, 1943, only two months after the surrender of the Axis forces in Tunisia (Keegan, 1989:347-350). Up to this point U.S. doctrine considered the resupply of attacking units over the bare beach to be very risky and early capture of one or more ports essential to sustain the invasion force. Because Eisenhower wanted to capture important airfields in southeastern Sicily that were not located near sea ports, Operation HUSKY was to be the first bare beach LOTS operation in history. King notes,

> For the first time, U.S. forces used the oceangoing landing ship tank (LST) and landing craft tank (LCT), vessels that could sail on their own from North Africa, participate in the assault, and return for resupply. (King and others, 1994:187)

Sicily also heralded the appearance of the 2 ½ -ton amphibian truck (DUKW), a highly effective vehicle for ship to shore movement of troops and cargo. Shortly after the invasion, Allied forces were able to “seize ports and other transportation facilities rather quickly, but the ports needed considerable repair so resupply over the beaches and through small southern ports continued until Palermo came on line” (King and others, 1994:187).

LOTS continued to play a role throughout the Italy campaign. When the Allies landed at Salerno, the port there could only accommodate small coastal vessels and over-the-beach resupply was used until the capture and partial rehabilitation of Naples (King and others, 1994:191). Naples later served as the port of embarkation for the amphibious assault at Anzio on January 22, 1944. This operation was intended to unhinge the German’s winter position and force them to withdraw to the north of Rome (Keegan, 1989:353-358). Maj. Gen. Lucas, commanding the assault, failed to gain the initiative and the Germans aggressively counterattacked his beachhead. Failure to secure the beachhead meant the operation had to be supported from the sea or risk complete disaster. According to King, two port battalions

> discharged cargo from Liberty ships, landing ships tank (LST), and landing craft. […LSTs] were loaded with 2 ½-ton trucks carrying 5 short tons of required items, backed onto the LST for rapid discharge at Anzio. (King and others, 1994:193)

The defense at Anzio was sustained for three months until Allied forces could provide relief over land from the south.

The experience gained in Sicily and Italy was vital to the successful planning and execution of Operations OVERLORD and DRAGOON, the invasions of Normandy and Southern France, respectively. As early as 1942, Lt. Gen. Somervell, Chief of Services of Supply, recognized that landing craft would be critical to future military operations (King and others, 1994:215). Even though some 82,000 landing craft were built in the U.S. throughout the war, they always seemed to be in short supply. This dearth of landing craft presented a problem and delayed the invasion of France in 1944. According to Keegan, Admiral King, Chief of Naval Operations,

> had a surplus of such vessels, particularly the crucial Landing Ship Tank, in the Pacific, but proved unwilling either to transfer any from one ocean to the other or to make available craft no longer needed in the Mediterranean. (Keegan, 1989:377)

As a result, Eisenhower was obliged to accept a postponement of the Normandy invasion from May until June, and the landing in the south of France, originally scheduled to coincide with the Normandy invasion, was delayed until mid-August (Keegan, 1989:377). The shortage of landing craft was a particular problem for Operation OVERLORD because the ships were to be used for repetitive cross-channel trips between the invasion site and England (King and others, 1994:223).

In spite of the shortage of landing craft, the Allies were ready to commence Operation OVERLORD by the end of May. Eisenhower set D-Day for June 6, 1944. The invasion of France was the pivotal campaign of the Western front because it was the beginning of the Allied thrust into the heart of Nazi Germany. The objective of the invasion was "to seize ports and a lodgment area in which troops and supplies could be built up and staged for offensive operations over a three month period" (King and others, 1994:207). The opening phase in the seizing of this lodgment area would be "a landing in the Caen sector with a view to the early capture and development of airfield sites in the Caen area, and of the port of Cherbourg" (Harrison, 1997:3). Normandy was chosen as the invasion site for a number of reasons, with logistics factoring into much of the decision making process. Five bare beach locations were chosen as landing sites for the amphibious assault. From east to west, the beaches were code-named SWORD, JUNO, GOLD, OMAHA, and UTAH. These sites were carefully chosen after considering several factors including German defenses, air range from England for fighter cover, suitability of the beaches for amphibious assault, and suitability of the beachheads for the reception of men and material following a successful amphibious landing. The proximity to the port of Cherbourg was an important factor since opening this port was one of the Allies early campaign objectives.

The invasion force consisted of 6,483 vessels, including over 4,000 landing craft and a naval bombardment force of 7 battleships, 23 cruisers, and 104 destroyers. Over 12,000 aircraft supported the invasion, including over 5,000 each of fighters and bombers and almost 2,000 transport aircraft. The transports delivered the parachutists of three airborne divisions and towed gliders filled with infantry, artillery, and engineers (Keegan, 1989:378). Men and material tasked to begin the logistics over-the-shore operation arrived immediately after the initial assault forces. According to Keegan,

> Behind the bombardment and amphibious squadrons sailed the craft bringing the infrastructure required by the assault waves…Assault engineers, manning amphibious bulldozers, demolition tanks, and fabric road layers, were to follow the assault waves at close interval. (Keegan, 1989:378).

The experience of the 453d Amphibian Truck Company was typical of the situation encountered by those units performing LOTS. The company arrived at OMAHA beach on D-Day with its DUKW's and drivers after traversing the channel on LSTs. The rest of the troops, including cargo handlers and support personnel, departed an LST in a separate landing craft to join the DUKWs once they reached the shore. Their craft was hit by enemy fire during debarkation, killing six men. The DUKWs, which debarked the LST more than 10 miles from shore, lost 17 of 53 craft during the beach landing (King and others, 1994:225). Besides enemy fire, there was mother nature to contend with as well. After being disgorged from their LSTs, high seas swamped the landing craft during their ten-mile journey to the shore. Over half, or 57 of 96, of the amphibious tanks assaulting OMAHA beach sunk, victims of heavy seas they had not been designed to withstand (Hammond, undated:17).

The Allies quickly succeeded in the ‘battle of the build-up,’ as Keegan called it. The British and Americans linked up the five beaches by 13 June and won the race to reinforce their position before the Germans could mount a successful counterattack. The English Channel was wholly under Allied control and became a highway for the transport of goods from Britain to the Continent. Not only was “the carrying capacity of the French roads and railways grossly inferior to that of the Allied transport fleet, but the whole interior of northern France lay under the eye of the Allied air forces” (Keegan, 1989:388). Until the port of Cherbourg was captured and rehabilitated for Allied use, a successful LOTS operation was the only guarantee of Allied logistical superiority.

Although the Allies won the ‘battle of the build-up’ and the invasion was a success, not all objectives were achieved as planned. The original plan was to capture Cherbourg within two weeks of the initial assault and extend the beachhead deep into Brittany. By that time, eighteen divisions were to have landed in France and thirty-three fighter squadrons were to have begun operating from a number of captured airfields (Harrison, 1997:5). In fact, Cherbourg was not captured until June 27, 1944, twenty days after the invasion, and was not reconstituted for use until July 16, 1944, a total delay of thirty-nine days. According to Hammond, by the time Cherbourg was in friendly hands,

> Enemy engineers had so thoroughly demolished the city’s harbor that it would take three weeks of rebuilding before the facility could open to even minimal shipping and months before it could handle cargo in quantity. (Hammond, undated:23)

This meant the Allies were forced to rely upon bare beach LOTS even more than they had originally planned. Fortunately, the bare beach proved adequate in spite of failing to achieve its planned throughput objectives.

As part of the LOTS plan, artificial harbors code-named MULBERRIES were created on OMAHA and JUNO beaches. These artificial harbors were designed to give the Allies "a measure of flexibility by allowing them to provision the force moving inland without having to rely upon the immediate capture of an established port" (Hammond, undated:6). The MULBERRIES were a precursor of the causeway systems and Rapidly Installed Breakwater System (RIBS) used in modern day LOTS. The MULBERRIES performed well until a storm lashed the French coast from 19-21 June. By King's account,

> Gale winds pounded the invasion coast, wrecking scores of craft and smashing the U.S. MULBERRY off OMAHA beach beyond repair. The British MULBERRY was not as severely damaged. It was repaired and handled 48 percent of all British support tonnage for the next three months. (King and others, 1994:225).

Hammond also indicates the severity of the storm by noting that the storm destroyed nearly 500 small craft and beached another 800 well above the high-water mark (Hammond, undated:23). Allied logisticians had achieved 73 percent of their targeted level of supplies through 18 June. By 22 June, as a result of the storm, that figure stood at 57 percent (Hammond, undated:23). Table 2, taken from King, is a summary of the planned versus actual throughput of cargo over the bare beach until the opening of Cherbourg. King states that "even though planned deliveries were not met, the landing of almost 290,000 long tons of supplies, and 71,000 vehicles in 25 days, was an unparalleled feat" (King and others, 1994:226). During the course of the entire LOTS operation, from the day of the invasion until ports assumed full responsibility for cargo reception in

Table 2. Throughput Over the Beaches, 6-30 June 1944

Date	Supplies (Long Tons)			Vehicles		
	Planned	Actual	% Achieved	Planned	Actual	% Achieved
D-Day	4,650	no record	--	6,810	2,870	42%
D+10	128,750	88,045	68%	52,606	34,549	66%
D+15	207,350	126,961	61%	74,482	44,567	60%
D+20	289,950	203,719	70%	95,170	58,612	62%
D+24	359,950	289,827	80%	109,921	70,910	65%

November of 1944, "some 1.265 million long tons of cargo were discharged at OMAHA and 726,000 at UTAH, plus thousands of personnel and vehicles" (King and others, 1994:226). Hammond also praises the operation by stating,

> logisticians quickly learned to bring what they needed directly across the beach. By the last week of June, OMAHA was averaging 13,500 tons of supplies per day, 115 percent of planned capacity, UTAH, meanwhile, had achieved 7,000 tons per day, 125 percent of its target. (Hammond, undated:23)

Operation OVERLORD demonstrated beyond a doubt that an invasion force could be supported in reasonably fair weather, with minimal resistance from the enemy, using bare beach LOTS procedures.

As ports were captured and reconstituted the Allies relied less upon the bare beach LOTS operations. According to King, this occurred in three phases:

> First was the capture of Cherbourg and the smaller ports in Normandy and Brittany, of which St. Michelle-en-Grève and Morlaix were the most important. The second phase consisted of the opening of Le Havre and other channel ports in the north and Marseilles, which served the southern lines of communication. In the third phase, Antwerp and the Belgian ports were opened. (King and others, 1994:226)

Cherbourg was the first major port opened when, on July 16, 1944, the port received four ships for lighterage discharge (King and others, 1994:227). Operations gradually improved from degraded port to robust port as engineers rebuilt facilities. By mid-September, five of 28 planned deep water berths were operational. Berth "reconstruction accelerated and … port capacity increased markedly from about 32,000 long tons in July to a peak of 433,000 in November" (King and others, 1994:228). The port at Cherbourg discharged a total of about 2.7 million long tons from its opening until the end of the war, a feat exceeded only by Marseilles (King and others, 1994:229).

Marseilles fell to the Allies shortly after the successful invasion of southern France on August 15, 1944. Meeting lighter than expected resistance from the Germans, the forces of Operation DRAGOON, as this invasion was code-named, covered 330 miles to join with forces at Normandy by September 15. An advanced party entered Marseilles on August 24 and the port was discharging lighters and amphibious craft by September 8. As King describes the situation, this was initially an in-stream discharge to a degraded port LOTS operation,

> On 15 September, the first Liberty ship was berthed. [Prior to that], most cargo was off-loaded to lighters, and troops and vehicles to landing craft, and beached in the port area. (King and others, 1994:200)

Marseilles was operational ahead of schedule and discharged more cargo than any other port in the European theater--4.1 million long tons and almost one million troops. (King and others, 1994:229). The ports of Le Havre and Rouen, while not achieving the throughput of Marseilles, were in better strategic locations because they were more in line with Allied troop advances.

Le Havre had suffered extensive damage from Allied bombing. Over-the-beach discharge was initiated on October 2 and rapidly progressed to port operations as facilities were repaired. By the end of the war on May 8, 1945, about 1.2 million long tons and over one million troops transited through Le Havre (King and others, 1994:229). Rouen was a smaller port up the River Seine from La Havre that was initially restricted to shallow draft vessels. By the end of the war, deep drafts berths were made available and the port discharged about the same tonnage as La Havre but far fewer personnel (King and others, 1994:229).

The crown jewel of European ports for the Allies was Antwerp, both because of its location and its immense capacity. It was captured in relatively undamaged condition and began operations on November 28, 1944. By mid-December the port was operating a full capacity, discharging up to 22,500 tons per day (King and others, 1994:229). The Belgian port of Ghent was the last of the major ports used by the Allies to sustain operations on the Continent. By the end of May, 1945, almost 800,000 long tons were discharged through Ghent (King and others, 1994:231). Table 3 summarizes the throughput accomplishments of the major Allied ports in Europe. In roughly 11 months the Allies discharged 15 million long tons of cargo and debarked 3.7 million passengers (King and others, 1994:231).

Table 3. Throughput of Ports, Date Opened to 8 May 45

Port Name	Date Opened	Months in Operation	Long Tons Discharged	Avg Monthly Discharge Rate	Peak Monthly Discharge Rate
Cherbourg	16 Jul 44	10	2.7 million	270,000/month	433,000/Nov 44
Marseilles	8 Sep 44	8	4.1 million	510,000/month	not available
La Havre	2 Oct 44	7	1.2 million	170,000/month	not available
Rouen	mid-Oct 44	6.5	1.2 million	185,000/month	not available
Antwerp	28 Nov 44	5.3	2.5 million	480,000/month	700,000/Dec 44
Ghent	mid-Dec 44	5	800,000	160,000/month	not available

Recall that the bare beach LOTS operations at Normandy achieved a throughput of 290,000 long tons of cargo in the first 25 days after the invasion. This compares very favorably with the average monthly discharge rates of the ports listed in Table 3, outperforming every average monthly rate except Antwerp and Marseilles. At peak capacity, the ports had much greater throughput than the beach but this was only after they were rehabilitated and robust. Each of the five beaches at Normandy had its own bare beach LOTS operation underway so the figure of 290,000 tons could roughly be divided by five to determine the average throughput of each beach. Regardless, the bare beach operations at Normandy were a tremendous feat and unequivocal success. World War II was a war of attrition fought by nations fully mobilized for war. We will now investigate the role and utility of LOTS in the more limited wars the U.S. military has fought since the end of the Second World War.

Korea to Kosovo

Korea was a divided nation at the end of WWII with Soviet forces occupying the north and American forces in the south. On June 25, 1950, the North Korean army invaded South Korea with the intent of forced reunification of the Korean peninsula. As South Korean resistance collapsed the United States, under the auspices of the United Nations, deployed forces to South Korea to repel the North Korean attack. By August of 1950 General MacArthur, the commander of the U.N. forces, faced a desperate military situation in South Korea. The invading North Koreans had overrun virtually the whole country. The remnants of the South Korean Army and U.N. reinforcements were penned in a small perimeter around Pusan, in the south-east of the peninsula (Royal Australian Army, 2000).

On September 15, 1950, MacArthur executed a brilliant amphibious assault at Inchon, just to the north of Seoul. The North Korean's rapid advance had stretched their army beyond the limits of its logistic support and they were completely outflanked by the Inchon landing. The U.N. forces captured Seoul by September 22 and proceed to push the North Korean army almost to the Chinese border. The amphibious assault was so successful and territory gained so quickly that there was no need to establish a bare beach

LOTS operation after the Inchon landing. During the six days of the amphibious assault, over 500 watercraft transported 49,000 soldiers, 5,356 vehicles, and 22,000 tons of cargo over the beach. Although bare beach LOTS was not used during the war, LOTS did contribute to port operations and intratheater sealift.

LOTS procedures were used extensively to augment the ports in Korea. King relates the situation at the Port of Pusan,

> Pusan had a significant shortage of harborcraft. With an overwhelming demand for dock space, lighterage was used to transfer cargo ashore from ships anchored in the harbor. As use of the port increased, the demand for lighterage exceeded available assets. (King and others, 1994:307)

Rated discharge throughput at Pusan was 45,000 tons per day but, because of the limited dock space, the actual daily discharge averaged only about 14,000 tons per day during 1951 (King and others, 1994:308). LOTS procedures were also used to perform intratheater sealift. When the Chinese entered the Korean War in December of 1950, the X Corps was forced to retrograde from the port at Hungnam to Pusan. Over 215,000 personnel, 18,000 vehicles, and 250,000 tons of supplies were moved on 193 watercraft in a two week period (King and others, 1994:316).

The Vietnam War was another instance when LOTS procedures were used primarily to perform port augmentation and intratheater sealift operations. In 1965, when the United States began to increase its military commitment in South Vietnam, the only port with any significant discharge capacity was the Port of Saigon and inland roadways were almost non-existent (King and others, 1994:338). Army engineers were charged with creating the infrastructure to support the burgeoning U.S. presence by building ports, lighter discharge facilities, depots, and roads. The port at Cam Ranh Bay, which was to become the primary port for sealift discharge, was built entirely by the U.S. Army

Corps of Engineers (King and others, 1994:337). Because the topography consisted of many rivers and canals, intratheater sealift using lighters, barges, and tugboats was often the most efficient means of transporting material within South Vietnam.

Much of the watercraft used in Vietnam were of WWII vintage, and over the years, the number had been reduced by budget cuts and obsolescence. Most of the vessels were drawn largely from reserve storage (King and others, 1994:336). King highlights the impact of this shortage in his text,

> Discharge problems were aggravated by the shortage of shallow-draft vessels, both military landing craft, mechanized (LCMs) and landing craft, utility (LCUs), which were used to discharge vessels when adequate berthing capabilities did not exist. (King and others, 1994:339)

The shortage of craft did impact operations but the military made due. In early 1965, the cargo flow into Vietnam was 140,000 tons per month. By late 1965 that figure had climbed to 460,000 tons per month, and then to 740,000 by the end of 1966 (King and others, 1994:336). By the end of December in 1967, the Army had ten ports in operation; seven deep-draft ports and three shallow draft-ports (King and others, 1994:341). Port augmentation LOTS increased the throughput of cargo discharge at each of these locations.

Two notable bare beach LOTS operations were also conducted during the Vietnam War. In September of 1965 the 394th Transportation Battalion was tasked with Operation HIGHLAND, the reception and onward movement of the 1st Cavalry Division into the Republic of Vietnam (King and others, 1994:349). To accomplish this assignment the 394th was required to discharge an entire division and bring it ashore in only two weeks. A bare beach LOTS operation was required because there were no docks or wharves available for ship offload. According to King, when HIGHLAND commenced on September 12, 1965, the 394th had,

> a unit strength of over 3,000 men and equipment that included four barge amphibious resupply cargo vessels (BARCs); nineteen LCMs; twenty-two LARCs; four LCUs; a floating crane; and a landing ship dock (LSD) provided by the Navy. (King and others, 1994:349)

He describes the operation as follows,

> LCUs loaded with troops plowed ashore at Blue Beach making more than 100 landings on the beach and unloading as many as 3,000 men a day. Once ashore, the men were immediately trucked to the helipad and flown to An Khe. Cargo was unloaded at Red Beach…Once the cargo was delivered to Red Beach, massive convoys were formed…to transport the 1st Cavalry Division to its area of operations. (King and others, 1994:350)

The operation concluded on September 28, sixteen days after it began. During the operation, 19,000 tons of cargo and "16,000 soldiers were unloaded from ships and moved over the beach and into a camp 70 miles away" (King and others, 1994:350).

The second bare beach LOTS operation of the Vietnam War was in support of I Corps on Wunder Beach, just south of the Demilitarized Zone on the South China Sea (King and others, 1994:348). Using the 5-ton LARC-V and the 60-ton LARC-LX, the 159th Transportation Battalion set up and operated a bare beach LOTS operation to alleviate the theater's overburdened ports. During the six-month LOTS operation,

> the 159th Transportation Battalion discharged an average of 1,000 short tons of cargo per day over the shore. The operation was terminated as a result of the monsoon season. [This] LOTS operation made possible the major U.S. summer offensives in I Corps that relieved Khe Sanh and swept the A Shau Valley. (King and others, 1994:349)

Wunder Beach and Operation HIGHLAND demonstrate that bare beach LOTS was useful to the warfighter during the Vietnam War, even if the procedure was only used twice during the decade of American involvement. Also note that the beach throughput was less than the throughput achieved during World War II by an order of magnitude.

This reflects a difference in scale between the operations as well as the dramatically reduced number of watercraft available in Vietnam. Port augmentation and intratheater sealift missions were also competing with bare beach LOTS for scarce watercraft assets.

Almost twenty years would pass before LOTS was used in support of military operations again. This time it was in 1983 for Operation URGENT FURY, the U.S. response to restore order and democracy on the island of Grenada. The U.S. Army Transportation Corps was tasked to "conduct fixed port, logistics over-the-shore, and terminal transfer operations" (King and others, 1994:378). According to King,

> Some 193 soldiers of the 7th Transportation Group…[set up] port operations at St. George's Port in Grenada. The soldiers participated in LOTS operations and loaded and off-loaded equipment and supplies from a fixed terminal operation. The first ship off-loaded was the RO/RO vessel, the *American Eagle*. Over 800 pieces of equipment were discharged to support combat operations. As soon as the ship was off-loaded, 7th Group soldiers backloaded over 378 short tons of captured arms and ammunition. (King and others, 1994:383)

This was a relatively short duration and straightforward LOTS operation; no bare beach procedures were used.

In 1989, LOTS operations were again used in Panama during Operation JUST CAUSE. Watercraft performed combat and combat service support missions on the Atlantic side of Panama and in the Canal (King and others, 1994:393). By December 31, 1989, eleven days into the operation, watercraft performing intratheater sealift "had transported 2,442 passengers, 848 prisoners, and 738 short tons of cargo. In addition, LCM-8 crews performed combat patrols and furnished suppressive fire for landing troops" (King and others, 1994:393).

The next major use logistics over-the-shore operations, the largest since World War II, was the Persian Gulf War. In August of 1990, Iraq invaded its neighboring country Kuwait and threatened the Kingdom of Saudi Arabia. The United States led a coalition that responded with a military build-up unprecedented in rapidity, scale, and scope. The logistics support for Operations DESERT SHIELD and DESERT STORM, the defense of Saudi Arabia and the liberation of Kuwait, respectively, was massive. King makes the comparison to Normandy,

> In a little more than a seven-month period more than 544,000 tons of supplies were airlifted, more than 3.4 million tons of dry cargo, and more than 6.1 million tons of petroleum products were moved by sea…greater than the cargo moved across the English Channel to Normandy [during a comparable period]. (King and others, 1994:412)

The majority of LOTS support to this effort was port augmentation, although bare beach operations played a minor role as well.

The reception facilities in Saudi Arabia and other host nations were modern and maintained to excellent standards. Even so, King describes the need for LOTS support,

> Even with the excellent port facilities at ad-Dammam and al-Jubayl, [LOTS] operations were still necessary. One LOTS operation was conducted at Ras Al Mishab in support of the U.S. Marine Corps for two and one-half months. First Marine Corps floating causeways were towed to the site and installed on the beach by Army tugs. Once established, two Army LSVs conducted sixteen missions carrying 16,495 short tons of cargo ashore while six LCUs conducted eighty mission transporting over 12,000 short tons. (King and others, 1994:417)

In total, Army watercraft performed 300 intratheater missions to support Marine Corps movements, a small fraction of the 6,100 total intratheater sealift movements (Crum, 2000). After the liberation of Kuwait, the Shuaiba harbor near Kuwait City was damaged so extensively that it was inaccessible to large vessels. Humanitarian support was desperately needed so a LOTS operation was established to transport relief supplies to the city. From March 1 through April 10, 1991, over 13,000 tons of cargo was transported by lighters through the damaged port (King and others, 1994:417).

The most recent LOTS operation was in the spring of 1999 supporting Operation NOBLE ANVIL, the NATO air campaign to end Serbia's persecution of Kosovar Albanians. The LOTS support was primarily intratheater sealift and augmented port operations; no bare beach LOTS were performed. Two Army LSVs were used to transport cargo between Italy, Albania, Croatia, Macedonia, and Greece. Over seventy-five intratheater trips were accomplished moving 267,000 tons of cargo and 1,466 passengers (Ramsay, 2000; Stanley, 2000). Task Force HAWK, the code-name for the unit move of Apache helicopter from Germany to Albania, was also supported with intratheater sealift. Over 6,700 tons of cargo were discharged by LSVs on twenty-two trips between Livorno and Brindisi, Italy, and Durres, Albania. Task Force HAWK's redeployment was supported with thirteen LSV trips moving 5,300 tons of cargo (Stanley, 2000). Eleven LSV trips were also made in support of Task Force SHINING HOPE, the humanitarian relief mission in Kosovo.

The preceding examples of LOTS operations since the end of World War II clearly demonstrate the important role this mission has in support of military campaigns. The greatest utility is derived from port augmentation and intratheater sealift LOTS, but bare beach operations have made critical contributions to the warfighter as well. Table 4 summarizes LOTS operations since WWII. Note that in only three instances over the

Table 4. LOTS Operations Since WWII

Name	Year	Bare Beach (# of Ops)	Port Augmentation	Intratheater Sealift
Korean War	1950-1953	NO	YES	YES
Vietnam War	1965-1973	YES (2)	YES	YES
Grenada (URGENT FURY)	1983	NO	YES	NO
Panama (JUST CAUSE)	1989	NO	NO	YES
Persian Gulf War	1990-1991	YES (1)	YES	YES
Kosovo (NOBLE ANVIL)	1999	NO	YES	YES

past 50 years has bare beach LOTS contributed significantly to an operation. Conversely, port augmentation and intratheater sealift LOTS operations have played a significant role supporting the logistics of every major military campaign. In the next chapter, we will turn our attention to present day LOTS capability and the expected utility that bare beach operations offer to the warfighter. This information will be derived from an investigation of the constraints that limit the utility of the bare beach operations, constraints identified through historical experience and training exercises.

IV. Bare Beach Constraints

In 1993, over 4,000 personnel participated in the largest logistics over-the-shore test in history, OCEAN VENTURE 93 (JLOTS III Throughput Test, 1994:3). The first ever combined JLOTS exercise was accomplished jointly with the Korean military at Pusan harbor in 1998 (Wolosz, 2000). Most recently, in 1999, the Army and Navy conducted a JLOTS exercise off the coast of Puerto Rico during CARIBBEAN THUNDER 99 (USTRANSCOM, 1999). Because these exercises were conducted in a controlled environment, rather than under operational conditions, exercise participants and observers were able to collect valuable information and make meaningful recommendations. Many themes emerge as lessons learned from these exercises and others like them. Highlighted are a host of known problem areas such as equipment interoperability, training and proficiency, too much dependence on the reserve force versus the active force, and doctrinal issues. These problem areas generally affect all LOTS operations to the same degree. This chapter will focus on problem areas having a disproportionate effect on the utility of bare beach LOTS operations.

Two themes, identified through training exercises and historical experience, have a demonstrably greater impact on the utility of bare beach operations than on other types of LOTS. The first is that watercraft are a constraint when performing bare beach LOTS. The equipment mix of watercraft is not optimum for the mission and the prepositioning strategy is not responsive to CINC requirements. The second is that bare beach LOTS capability is unsatisfactory in anything but relatively calm seas, degrading rapidly in worsening sea state conditions. This chapter will address these constraints and examine their impact on the utility of bare beach LOTS operations.

A third constraint affecting bare beach LOTS does not pertain to the operation per se, but is a function of the beach itself. The nature of the bare beach is that it does not have an existing logistics or transportation infrastructure. The third section of this chapter will discuss how this lack of infrastructure constrains LOTS throughput, especially beach clearance and onward movement of cargo. This analysis is primarily a qualitative assessment of LOTS throughput over an undeveloped shore. After examining these three constraints, we will have enough information to assess the utility that bare beach LOTS operations present to the warfighter. This will be covered in the final chapter.

Watercraft

When theater commanders decide that LOTS is required to support a military operation, they would ideally have all the manpower and equipment necessary to commence the operation on hand. This would entail either adequate lead time to deploy LOTS equipment to the area of operations, or prepositioning the equipment at every conceivable LOTS location in their area of responsibility (AOR). Neither of these options is realistic. Prepositioning limited number of key assets and having a deployment plan for follow-on watercraft forces is the Army's strategy to accomplish the LOTS mission. The watercraft program manager at Army Combat Arms Support Command (CASCOM) identified four challenges facing the fleet (Crum, 2000; Aube, 2000):

1) Global Responsiveness - Current structure, stationing, and pre-positioning strategies do not fully support and are not globally responsive to support warfighting requirements.

2) Support CINC Requirements - There are no vessels pre-positioned in or near CINC AORs. Most vessels are CONUS-based. Sailing from CONUS to CINC AORs is not possible for most vessels. Those that

can sail from CONUS would not be in place in time to support early LOTS, intratheater lift, and port opening requirements.

3) Balance the Force - Restructuring with a force mix that best supports the warfighters.

4) Re-Capitalize the Current Fleet - Sizing the fleet with only those systems that provide efficient and effective support to the warfighters is critical.

The current prepositioned fleet of watercraft is not an optimal solution because the equipment is inadequate and the prepositioned locations are not responsive to CINC requirements.

The purpose of prepositioning is to locate sufficient Army watercraft overseas, either afloat or forward stationed, in order to meet reaction times and throughput requirements of the theater CINCs. According to the Army Watercraft Master Plan (AWMP), "Today, the prepositioned fleet of watercraft *does not* meet Army Strategic Mobility Plan requirements" (AWMP, 1999:4-1). The adverse impact of this inadequacy is most severe on bare beach LOTS operations. Recall that bare beach LOTS requires a greater planning and preparation time than other forms of LOTS, typically 14-30 days depending on the operation. Add to this the steam time required to deploy assets to an area of operations and the time required to download and prepare the watercraft, and the utility of the LOTS operation diminishes rapidly.

The implications for the warfighter are severe. As a hypothetical example, consider a bare beach LOTS operation on the Korean peninsula. Assume watercraft are prepositioned on MPS ships at Diego Garcia. From the moment the CINC decides to execute the bare beach LOTS operation, the MPS ships will require approximately two weeks to sail from Diego Garcia to Korea. Upon arrival the watercraft will require four or more days to download from the MPS ships and prepare for LOTS duties. Preparation of the beach and construction of a causeway may require an additional two weeks. Total time, from execute order to commencing the bare beach LOTS, is a minimum of 30 days (Crum, 2000). Add another two weeks if an elevated causeway is required. This is acceptable if the warfighter has adequate lead time to prepare for the operation but it is certainly not responsive to immediate needs.

Compounding the watercraft prepositioning problem is the equipment mix of the watercraft themselves. The premise of the watercraft requirement is the ability to off-load an afloat heavy brigade in six days (AWMP, 1999:4-3). The heavy brigade is assumed to consist of 67,000 tons of vehicles and equipment aboard four LMSRs. The brigade would be discharged in-stream and transported to the beach using lighterage and floating causeways (Crum, 2000). That translates to roughly 11,000 tons per day. This is what the warfighters plan on and expect from a LOTS operation. According to CASCOM,

> The current number and mix of craft in the Army inventory is not adequate to execute the prepositioning strategy. Limited procurement of LSVs and LCU-2000s is required before the necessary prepositioned watercraft capability can be deployed. (AWMP, 1999:4-5)

Additionally, some of the watercraft have exceeded their useful life and need to be divested from the active fleet or undergo extensive overhaul for service life extension. In particular, the LCU-1600 "is aging and in 1996 reached the end of its useful life" (AWMP, 1999:5-11). It will eventually be replaced with the LCU-2000, a vessel with 60 percent greater cargo movement capability. The Army is aware of its equipment limitations and is implementing a watercraft modernization program that "charts the course for the continuous modernization of the fleet through the year 2012" (AWMP, 1999:6-1). The program calls for maintaining and modernizing existing craft, divesting old craft, and procuring new craft to ensure LOTS capability is available. Until the program is fully implemented, however, the warfighters will not have their required LOTS capability. Again, because the most efficient use for limited watercraft assets will likely be intratheater lift and port augmentation operations, the utility of bare beach LOTS will suffer most from equipment shortfalls.

Sea State

The greatest constraint on LOTS operations, and bare beach LOTS in particular, is the inability to deliver cargo over the shore in anything but calm seas. Exercises and operational experience have shown that "weather and sea state conditions are the single most significant variables in cargo throughput calculations" (Thede and others, 1995:1-2). The standardized measure for sea state is the Peirson-Moskowitz scale, starting at Sea State 0 with calm winds and no waves and progressing to storm conditions at Sea State 6 and above. In 1993, all regional command CINCs promulgated, via official notification to U.S. Transportation Command, that conducting JLOTS operations in Sea State 3 was not a desire, but was instead a requirement (Workman, 1996:48). We do not have that capability today. The Joint Staff published the following statement regarding sea state,

> Today, JLOTS capability is unsatisfactory and is only capable of delivering forces through Sea State 2 [wave height 0-3 feet, wind 0-10 kts]. The end state CINCs require is the capability to operate through Sea State 3 [wave height 3-5 feet, wind 11-16 kts] … This will enable the CINCs to operate throughout most of their area of operation approximately 75 percent of the time. (J4 Roadmap, 1998)

Developing this capability is a tremendous challenge. The military's ability to perform LOTS in anything but relatively calm seas has not markedly improved since WWII.

In 1995, the Logistics Management Institute (LMI) compiled a report on JLOTS throughput. They analyzed the anticipated throughput requirements of each of the five regional warfighting CINCs, referred to as CINC 1 through CINC 5 in the report to avoid divulging classified information. Sea state was one area evaluated to assess JLOTS capability. Table 5, taken from the LMI report, indicates how frequently various sea state levels can be anticipated over a one-year period in each of the CINC's areas of responsibility (Thede and others, 1995:2-12). This table indicates that the warfighters can plan on having maximum LOTS throughput only 40 to 60 percent of the time (SS0 to SS1). By including Sea State 2 conditions the table indicates that the CINCs can derive some utility from degraded LOTS approximately 60 to 75 percent of the time. These percentages do not mean that throughput capability is simply degraded during LOTS operations, it means that at certain times during the year no LOTS operations can be performed. The percentages in the LMI report roughly translate to having no LOTS capability whatsoever during three to five months of the year. The CINCs are at the mercy of calm seas, a situation an enemy could exploit by timing operations to coincide with seasonal rough weather periods.

Table 5. Sea State in CINC's Areas of Responsibility.

Region	Percent of Time SS0 - SS1	Percent of Time SS2	Percent of Time SS3 and above
CINC 1	40	20	40
CINC 2	48	14	38
CINC 3	57	13	30
CINC 4	60	16	24
CINC 5	53	17	30

During the exercise OCEAN VENTURE 93, ships "experienced major difficulties discharging cargo during high Sea State 2. No operations took place in Sea State 3" (JLOTS III Throughput Test, 1994:10). The nature of the sea state problem is multifaceted (Workman, 1996:28). In some cases the limiting factor is the wave height of Sea State 3 waves, which is three to five feet. In other cases, it may be the frequency of the waves, a characteristic affecting the performance of LOTS equipment such as cranes. Or it may be the high winds associated with Sea State 3. Workman identifies seven specific obstacles that Sea State 3 conditions impose on LOTS operations (Workman, 1996:29):

1) Launching lighterage (barges, LASH modules, landing craft, etc).
2) Need for extensive fendering between ships, lighters, and staging facilities (discharge platforms, causeways, RRDF, COLDS).
3) Inability to off-load via crane due to excessive relative motion.
4) Inability to deploy bulk fuel offload equipment.
5) Extreme difficulty constructing any type of causeway.
6) Extreme difficulty constructing discharge facilities (RRDF, COLDS).
7) Sea water washing over the surface of causeways and discharge facilities due to inadequate freeboard.

Overcoming these obstacles will require new technologies and methodologies. The Joint Staff and U.S. Transportation Command have taken the first steps toward alleviating Sea State 3 deficiencies. The Amphibious Cargo Beaching Lighter (ACBL) is a causeway system which expands on the technology of the Army's current Modular Causeway System (MCS) to produce more freeboard area and provide greater stability in high seas (Workman, 1996:31). Preliminary design tests indicate that the ACBL does not succumb to the effects of wave action until Sea State 5 conditions are encountered (Workman, 1996:31). Another system is the Joint Modular Lighter System (JMLS) which is programmed to be fielded during fiscal years 2002 to 2005 (Watkins, 2000). Systems such as these do not enable a full Sea State 3 operating capability in and of themselves.

The final solution can only be obtained by concurrent development of compatible systems and proven methods of integration.

Until LOTS equipment is fielded that can meet the CINC's sea state requirements, the utility of LOTS operations to the warfighter will suffer. During WWII a storm off the coast of Normandy shut down LOTS operations for several critical days by destroying the American MULBERRY artificial harbor and hundreds of watercraft. During the Vietnam War the LOTS operation at Wunder Beach was halted at the beginning of the monsoon season due to inclement weather. For the warfighter to rely upon LOTS to successfully prosecute a campaign would be sheer folly. In spite of these limitations, history reveals that bare beach LOTS operations can have a role in support of the warfighter. To ensure adequate utility for the future and mitigate the risks of adverse sea states, the capability of LOTS must either be improved or an alternative logistics support system must be developed. These ideas will be explored in the next chapter but first the nature of the beach itself will be examined as a limiting constraint.

Infrastructure Beyond the Beach

The second half of the 20th Century was a period of unprecedented growth and development around the globe. Civilization pushed back the boundaries of the wilderness and left almost no region on the globe untouched by man. This is especially true of the coastal regions and waterways that make up modern transportation networks and trade routes. One need only travel a short distance along any coastline before encountering some form of port, harbor, or fishing village. The sites where these towns and villages developed were not selected randomly. They were chosen because they lie along lines of communication, because they provide access to inland regions, and because they are protected from the open seas. These are the same characteristics favored by a military commander when selecting a location for logistics over-the-shore operations.

Civilization has expanded such that any remaining bare beaches are usually bare because the location is not suitable for transportation or economic development. This is the third major constraint on bare beach LOTS operations. Even if men and material can get from the ship to the shore, the onward movement from the bare beach is an obstacle almost as daunting to the warfighter. There are no roads, there is no railhead, and there are no airports. Moving the M1 Abrams main battle tank or the M2 Bradley infantry fighting vehicle any distance beyond a few miles requires either a flatbed railcar with a good railway system or a heavy equipment transporter (HET) with a good highway system. The heavy expanded mobility tactical truck (HEMTT) has limited performance off-road but works best when used on existing roadways. By building upon existing infrastructure in an area of operations, the warfighter's logistics support system can realize tremendous efficiencies.

The bare beach still has an important role in military operations but its role as a logistics channel does not have much utility for the warfighter. The bare beach is an appropriate site for amphibious operations, operations which are self-sustaining during the initial assault phase. By current military doctrine, the assault follow-on forces will arrive within five days of the assault landing and have enough logistics support to sustain the amphibious operation for up to thirty days (Joint Pub 4-01.6:Sec II, 11). If the bare beach is abandoned as a LOTS option then one of the objectives of an assault landing must be to secure a port location. By seizing a port, even if only a small fishing village, the logistics flow could begin as an augmented port LOTS operation rather than as an inefficient, costly, and risky over-the-beach operation.

This chapter reviewed two of the most restrictive constraints on bare beach LOTS operations, the location and force structure of watercraft and sea state minimums. Lastly, the nature of the bare beach itself was examined and its suitability for logistics over-the-shore questioned. Each of these three factors highlight the limited utility that bare beach LOTS operations provide for the warfighter. The next chapter will ask if it is a reasonable proposition to abandon bare beach LOTS operations. Can the modern expeditionary military supply and sustain itself without a bare beach over-the-shore logistics capability?

V. Adequate Utility?

This research paper is a critical review of bare beach LOTS to determine if this operation provides adequate utility for today's military. Chapter II defined logistics over-the-shore and described unique characteristics of the bare beach operation. It emphasized that LOTS is a large-scale and very complex operation that must be conducted in a permissive environment. It demonstrated that bare beach LOTS requires more planning and preparation than other forms of LOTS, making it more costly to the warfighter in terms of time and resources. Chapter III reviewed the history of LOTS since the Second World War. The role of LOTS in military campaigns gave an appreciation of how this operation supports the warfighter. Historical data revealed how bare beach LOTS has, on average, a throughput rate at least one order of magnitude less than the throughput rate of port discharge. The historical record also showed that in the fifty years since WWII, only three bare beach LOTS operations were conducted to support major military campaigns, twice in Vietnam and once in the Persian Gulf. The record strongly indicates that watercraft are used most effectively when performing port augmentation and intratheater sealift missions rather than bare beach LOTS operations.

Chapter IV gave the most damaging evidence that the warfighter derives little utility from bare beach LOTS. Three constraints were identified that limit the utility of this operation. The current watercraft fleet can not perform its mission because it consists of equipment that does not have the capacity or capability to meet CINC requirements. Additionally, the current watercraft fleet is not strategically positioned for crisis response. A second, and more intractable constraint, is the inability to perform any form of in-stream discharge or bare beach LOTS through Sea State 3 conditions. Lastly, the utility of the bare beach itself was questioned. The nature of the beach and lack of transportation infrastructure beyond the beach demands a determination of whether or not bare beach logistics is an outdated concept. The correct answer to this question must be derived from the warfighter's perspective. Operational requirements drive the LOTS process so we must determine what the warfighters will lose without bare beach LOTS.

Operational Costs of Abandoning the Beach

From a logistician's perspective, bare beach LOTS is a high-cost, high-risk, and inefficient means of supporting the warfighter. If the bare beach could be abandoned, in favor of other less costly logistic solutions, what would the implications be for the warfighter? The focus is on the needs of the warfighter--this is where the logistics support begins. From the basic campaign plan, the warfighters and their staffs assess how best to support their campaigns. The logistics plan is developed by working backwards from the campaign objectives in a way that satisfies support requirements in the least costly manner. LOTS, in each of its varieties, is one of many capabilities available to the warfighter to meet those requirements. Other capabilities include ground lines-of-communication, strategic and intratheater airlift, logistics bases, supply depots, and pipelines. Without the bare beach option, the warfighter loses flexibility. According to Wolosz, "what you may have is a situation where the logistically superior location is the operationally inferior location or vice versa. This is why the focus must be on the [warfighter's] requirement" (Wolosz, 2000).

Wolosz tells us that bare beach LOTS may be required regardless of the logistical costs. His argument is paraphrased in the following (Wolosz, 2000). He states, it is correct that degraded ports, even fishing villages, will offer significantly higher throughput rates and are less labor intensive to conduct than bare beach LOTS. Also, there are not many locations around the world where some form of village pier or small port is not available. From a logistical analysis alone, the degraded port is always the way to go and bare beach LOTS should be the last option. But the logisticians do not drive the scheme of maneuver or the campaign plan. LOTS must occur in a permissive environment because the systems and units are not equipped to operate under enemy fire. To make an area benign, the warfighter must expend resources to clear enemy threats and ensure continued area security. It is far easier to secure and clear a bare beach, located in a desolate area, than a port or small town. Combat units on the offensive require speed, maneuver, and concentration of force. They may bypass regions of enemy territory or pockets of resistance in pursuit of larger objectives. The problem is that even a small threat, while not worth stopping the momentum of the main assault, could be a significant threat to a LOTS operation.

The beach may be a better choice than the port for other reasons as well. Recall the ports of Cherbourg, Le Havre, and Rouen in WWII, and the port and harbor of Kuwait City during the Persian Gulf War required time and resources to rehabilitate before they could be used for supply and sustainment. Wolosz states, “port areas and channels are susceptible to defensive mining, obstacles, etc. We may have mined them ourselves earlier in the campaign to deny their use to the enemy” (Wolosz, 2000). Delays incurred for port rehabilitation could impose too much operational cost. Preparing and clearing a bare beach may require less time and be a better solution to meet the needs of the warfighter. Wolosz sums it up best by stating,

> Satisfying the requirement at the lowest operational cost is the answer and that may very well be a bare beach. It’s a matter of where you want to

> accept risk--do you want to accept risk in resupply to maintain speed or do you want to accept risk by slowing down to ensure uninterrupted support? (Wolosz, 2000)

The operational cost of abandoning the logistical support option of bare beach LOTS is too great for the warfighter to bear. Having the warfighter's perspective, we can now address the question of the utility of bare beach LOTS operations.

The Future of LOTS

This research paper sought to answer the question of whether or not bare beach LOTS operations provide adequate utility for today's military. The answer is no, today's military does not derive adequate utility from bare beach LOTS. Not with current LOTS capability. But the bare beach, as a means of accomplishing LOTS, does have utility for the military of today and tomorrow. When compared to other methods of logistic support, bare beach LOTS is expensive, risky, unreliable, and inefficient. But it can be effective and it definitely has a place in the military arsenal. It is a key enabler of America's power projection strategy. It is a unique capability of the United States armed forces, a capability possessed by no other nation.

For these reasons, bare beach LOTS capability must be improved and enhanced to meet CINC requirements. New technologies are part of the solution. The Amphibious Cargo Beach Lighter (ACBL) and the Joint Modular Lighter System (JMLS) mentioned in Chapter IV are two such systems currently undergoing testing and development. Other systems include the Theater Logistics Vessel (TVL) and the Surface Effects Vessel (SEV), hybrid transports that will deliver more cargo than an LSV directly to the beach at speeds approaching 80 knots (Watkins, 2000). But these systems are years away from operational readiness. There are steps that must be taken today, using existing force structure, to improve bare beach LOTS capability.

Implementing the recommendations and lessons learned from exercises and operational experience has improved our LOTS capability over the past several years. These initiatives must continue. The current watercraft fleet, even if unable to meet all CINC requirements, can still be enhanced by implementing some straightforward changes. The fleet requires a more responsive prepositioning plan, a joint plan developed with inputs and full support from both the Army and the Navy. Training and education needs more emphasis. Not only equipment and interoperability training for LOTS personnel, but training for commanders as well. The CINCs and their staffs, Joint Task Force commanders and their staffs, and service component commanders need to understand the capabilities and limitations of LOTS operations. Finally, programming and budgeting decisions made today will affect LOTS operations of the future. Senior leadership in the military and the administration must determine requirements and make policy decisions towards achieving those goals.

Conclusion

This paper reviewed bare beach LOTS in an attempt to assess the utility of this operation. The nature of the operation, including the processes and equipment, was reviewed in Chapter II. Chapter III gave a historical perspective of how LOTS operations have supported warfighters in military campaigns of the past. This perspective was insightful for understanding the benefit and utility of LOTS in both the past and present day. Chapter IV examined three constraints limiting the utility of bare beach LOTS; watercraft equipment and location, sea state minimums, and the lack of infrastructure beyond the beach. The review of bare beach LOTS in these three chapters revealed that the operation is costly, risky, and of limited utility.

In the final chapter, however, we examined bare beach LOTS from the warfighter's perspective. Seen in this light, bare beach LOTS capability is an extremely important capability. Although it may not be the best logistical solution, there are many situations where it is the best operational solution. The military necessity to perform a bare beach LOTS operation may not arise for many years, if ever, but the United States military needs to be trained and equipped to execute this mission now and in the future. This paper argues that it is vital to our national military strategy.

Appendix A: Glossary of Terms

ACBL	Amphibious Cargo Beaching Lighter
ACV	Air Cushioned Vehicle
ACVLAP	Air Cushioned Vehicle Landing Platform
AOR	Area of Responsibility
ASMP	Army Strategic Mobility Plan
AWMP	Army Watercraft Master Plan
BARC	Barge, Amphibious Resupply Cargo
CINC	Commander-in-Chief
COLDS	Cargo Offload and Discharge System
CF	Causeway Ferry
CSP	Causeway System, Powered
DUKW	2 ½ Ton Amphibian Truck
ELCAS	Elevated Causeway System
FC	Floating Causeway
FLO/FLO	Float-on/Float-off
FSS	Fast Sealift Ship
HEMTT	Heavy Equipment Mobility Tactical Truck
HET	Heavy Equipment Transporter
HMMWV	High Mobility Multi-purpose Wheeled Vehicle
JLOTS	Joint Logistics Over-the-Shore
JMLS	Joint Modular Lighter System
LARC	Lighter, Amphibious Resupply Cargo
LASH	Lighter Aboard Ship
LCAC	Landing Craft, Air Cushioned
LCM	Landing Craft, Mechanized
LCT	Landing Craft, Tank
LCU	Landing Craft, Utility

LMI	Logistics Management Institute
LMSR	Large, Medium Speed Roll-on/Roll-off Ship
LO/LO	Lift-on/Lift-off
LOTS	Logistics Over-the-Shore
LSD	Landing Ship, Dock
LST	Landing Ship, Tank
LSV	Logistics Support Vessel
MCS	Modular Causeway System
MHE	Material Handling Equipment
MPS	Maritime Prepositioned Ship
RIBS	Rapidly Installed Breakwater System
RO/RO	Roll-on/Roll-off
RRDF	RO/RO Discharge Facility
RRF	Ready Reserve Fleet
RT	Rough Terrain
RTCH	Rough Terrain Container Handler
SEV	Surface Effect Vehicle
SS	Sea State
T-ACS	Auxiliary Crane Ship
TVL	Theater Logistics Vessel

Appendix B: LOTS Equipment

Information contained in this appendix was compiled from multiple sources including Joint Pub 4-01.6, the U.S. Army Watercraft Master Plan, Beary, Buchanan, and Thede.

Logistics Support Vessel (LSV)

Owning Service:	Army
Number Possessed:	6
Mission:	Transport cargo in ocean, coastal, and inland waterways
Transportability:	Self-deploy
Cruising Range:	8,200 nautical miles empty; 5,500 nautical miles loaded
Length:	273 feet
Beam:	60 feet
Draft (Full Load):	12 feet forward, 16 feet aft
Speed (Full Load):	12 knots
Crew:	29
Cargo Capacity:	2,000 short tons with 10,500 square feet of deck area
Typical Loads:	24 M1A1 main battle tanks, or 50 wheeled vehicles, or 15 forty-foot containers (single stacked) 25 twenty-foot containers (single stacked) NOTE: Containers can be stacked two high in intracoastal tranport role, thus doubling the number carried.

Landing Craft, Utility (LCU-2000)

Owning Service:	Army
Number Possessed:	35
Mission:	Transport cargo from strategic sealift ship to shore in areas that cannot be reached by ocean-going vessels. Also operates in coastal and inland waterways.
Transportability:	Self-deploy; however, preferred method is heavy lift or float- on/float-off ship
Cruising Range:	4,500 nautical miles
Length:	175 feet
Beam:	42 feet
Draft (Full Load):	5 feet forward, 9 feet aft
Speed (Full Load):	11 knots
Crew:	12
Cargo Capacity:	350 short tons with 2,500 square feet of deck area
Typical Loads:	5 M1A1 main battle tanks, or 13 wheeled vehicles, or 2 forty-foot containers (single stacked) 7 twenty-foot containers (single stacked)

NOTE: Containers can be stacked two high in intracoastal tranport role, thus doubling the number carried.

Landing Craft, Utility (LCU-1600)

Owning Service:	Army and Navy
Number Possessed:	Army - 13; Navy - 41
Mission:	Transport cargo, troops, and vehicles from ship to shore in areas that cannot be reached by ocean-going vessels. Also used for lighterage and utility work in harbors and inland waterways.
Transportability:	Amphibious ships, deck loaded on commercial ships, heavy lift, or float-on/float-off ships
Cruising Range:	1,200 nautical miles
Length:	135 feet
Beam:	29 feet
Draft (Full Load):	3 feet forward, 6.5 feet aft
Speed (Full Load):	11 knots
Crew:	12
Cargo Capacity:	187 short tons with 1,800 square feet of deck area
Typical Loads:	2 M1A1 main battle tanks, or 4 wheeled vehicles, or 3 forty-foot containers (single stacked) 4 twenty-foot containers (single stacked)

NOTE: Containers can be stacked two high in intracoastal tranport role, thus doubling the number carried.

Landing Craft, Mechanized (LCM-8)

Owning Service:	Army and Navy
Number Possessed:	Army - 114; Navy - 60
Mission:	Transport cargo, trooops, and vehicles from ship to shore in areas that cannot be reached by ocean-going vessels. Also used as a lighter in harbor and inland waterways.
Transportability:	Deck loaded on commercial ship or float-on/float-off ship
Cruising Range:	270 nautical miles loaded
Length:	74 feet
Beam:	21 feet
Draft (Full Load):	4 feet forward, 5 feet aft
Speed (Full Load):	12 knots
Crew:	5
Cargo Capacity:	65 short tons with 620 square feet of deck area
Typical Loads:	1 light tracked vehicle, or 1 wheeled vehicle, or 1 twenty-foot container

Lighter, Amphibious Resupply Cargo, 60-ton (LARC-LX)

Owning Service:	Army
Number Possessed:	12
Mission:	Transport tracked and wheeled vehicles, including beach preparation equipment, and sustainment cargo from ship to shore. The LARC-LX is the only amphibian in the U.S. Army inventory and the only vessel capable of landing on a beach through breaking surf.
Transportability:	Deck loaded on commercial vessel
Length:	63 feet
Beam:	27 feet
Draft (Full Load):	9 feet (LARC is a wheeled vehicle that drives onto beach)
Speed (Full Load):	7 knots
Crew:	8
Cargo Capacity:	60 short tons
Typical Loads:	125 combat troops, or 2 wheeled vehicles, or 4 twenty-foot containers, or 2 forty-foot containers

Landing Craft, Air Cushioned (LCAC)

Owning Service:	Navy
Number Possessed:	89
Mission:	Rapid transport of cargo, troops, and vehicles directly onto the shore in amphibious operations.
Transportability:	Navy amphibious ship or commercial barge ship
Cruising Range:	110 nautical miles loaded
Length:	88 feet
Beam:	47 feet
Draft (Full Load):	N/A (LCAC is a hovercraft that drives directly onto beach)
Speed (Full Load):	40 knots
Crew:	5
Cargo Capacity:	65 short tons with 1,900 square feet of deck area
Typical Loads:	1 M1A1 tank and 3 HMMWV, or 4 trucks and 3 HMMWV, or 9 HMMWV

Causeway Ferry (CF) or Causeway System, Powered (CSP)

Owning Service:	Army and Navy
Number Possessed:	Army - 6 CSP+3; Navy - 64 CSP+2 and 13 CSP+1
Mission:	Transport rolling stock, containers, and breakbulk cargo from ship to shore.
Transportability:	Any commercial cargo ship
Length and Beam:	Army module is 40 feet long and 12 feet wide (ISO standard container size), two modules in parallel form one section; Navy section is 90 feet long and 21 feet wide
Configurations:	CSP+1 (powered section plus one non-powered section) CSP+2 (powered section plus two non-powered sections) CSP+3 (powered section plus three non-powered sections)
Speed:	5 knots
Crew:	5
Cargo Capacity:	350 short tons (CSP+3)
Typical Loads:	3 M1A1 tanks, or 16 wheeled vehicles, or 24 twenty-foot containers, or 12 forty-foot containers

Floating Causeway (FC)

Owning Service:	Army and Navy
Number Possessed:	2 - Army; 6 - Navy
Mission:	Provide a dry bridge for the discharge of cargo from lighters directly to the beach.
Transportability:	Modular causeway sections in standard ISO 40-foot container size; deployable aboard container ship or other cargo vessel.
Crew:	33 for 24-hour operations
Description:	Modular floating causeway sections are assembled into a floating causeway pier that extends from the beach to a depth accessible by lighterage. Causeway consists of one beach/sea section, up to 23 modular causeway sections, and two powered sections. These same sections can be used to assemble an Roll-on/Roll-off Discharge Facility (RRDF).

Elevated Causeway System (ELCAS)

Owning Service:	Navy
Number Possessed:	2
Mission:	Provide a dry bridge for the discharge of cargo from lighters directly to the beach.
Transportability:	Any commercial cargo vessel
Description:	Temporary bridging structure that extends as much as 3,000 feet from the shoreline to reach a water depth of 20 feet, at which point barge ferries and other lighterage can come alongside and discharge their cargo.

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Vita

Major Christopher J. Pehrson was born in Flint, Michigan. In May of 1987 he graduated from the University of Michigan with a Bachelor of Science degree in Computer Science. He was commissioned an officer in the U.S. Air Force through the university ROTC program.

In July of 1987, he attended Undergraduate Navigator Training at Mather AFB, California. Upon graduation he was assigned to Mountain Home AFB, Idaho, for Electronic Warfare Officer training in the EF-111. His first operational assignment was with the 42nd Electronic Combat Squadron at RAF Upper Heyford, United Kingdom. During his tour of duty in England he deployed to Taif, Saudi Arabia, where he flew thirty combat missions during the Persian Gulf War and was awarded the Distinguished Flying Cross. While at Upper Heyford he also completed a Master of Science degree in Computer Information Systems through Boston University's overseas program.

In 1991, he was selected to attend Undergraduate Pilot Training at Laughlin AFB, Texas. Upon graduation in 1992, he was assigned to the 37th Airlift Squadron flying the C-130 at Rhein-Main AB, Germany. He moved with his unit to Ramstein AB, Germany, in 1994. During his tour of duty in Germany, he flew over 100 missions to Bosnia in support of United Nations and NATO humanitarian relief and peacekeeping operations.

In 1997, he was assigned to the Air Mobility Operations Control Center at Hickam AFB, Hawaii, where he worked as an Airlift Director. In May of 1999, Major Pehrson was assigned to the Air Mobility Warfare Center, Advanced Study of Air Mobility program. After graduation, he will attend Army Command and General Staff College at Fort Leavenworth, Kansas.

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Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This paper is a critical review of bare beach logistics over-the-shore (LOTS) operations. It examines the utility of the bare beach and asks if this method of LOTS is still viable for today's military. It begins with a general description of LOTS and describes unique characteristics of the bare beach operation. It then reviews the history of LOTS from World War II through the present day. This historical perspective gives insight into the utility that LOTS provided in past campaigns and what might be expected of LOTS in support of present day operations. It then investigates three constraints limiting the utility of bare beach LOTS operations: number and location of watercraft, sea state minimums, and infrastructure beyond the beach. This review of bare beach LOTS reveals that it is a high-cost, high-risk, and often unreliable operation that does not meet operational requirements of the regional warfighting CINCs.

Next the operation is viewed from the warfighter's perspective. From this vantage, bare beach LOTS may be the logistics support option with the lowest operational cost, and therefore of great utility regardless of the logistical cost. In conclusion, this paper emphasizes the need to improve and enhance bare beach LOTS capability to adequately support the warfighter.

14. SUBJECT TERMS

Logistics Over-the-Shore, LOTS, Joint Logistics Over-the-Shore, JLOTS, Beach, Logistics, Watercraft, Landing Craft, Augmented Port, Degraded Port, Intratheater Sealift

15. NUMBER OF PAGES

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